

## NOTES ON AUSTRALASIAN SIMULIIDAE (DIPTERA). II.

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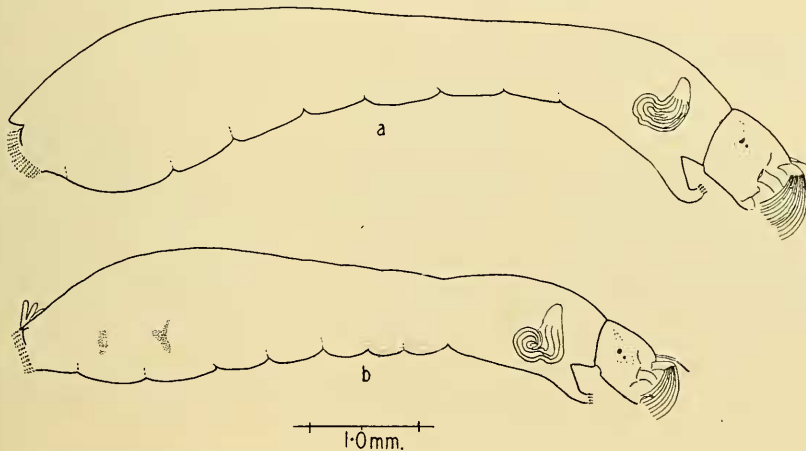
(Fifteen Text-figures.)

[Read 28th June, 1950.]

## INTRODUCTION.

Since our previous paper (1949), we have accumulated a considerable quantity of new material, much of which was obtained during a tour of Cape York and north-eastern Queensland. The present notes include observations on the *aurantiacum* group of *Cnephia*, descriptions of five new species (one *Cnephia*, three *Simulium*, one *Austrosimulium*), a new subspecies of *Cnephia tonnoiri* Drum., the early stages and male of *Simulium faheyi* Tayl., and records extending the known distribution of previously described species. The Queensland fauna has been increased from nine to seventeen species.

References listed in our earlier papers are not repeated here.



Text-fig. 1.—Lateral view of larvae of (a) *Cnephia tonnoiri orientalis*, and (b) *Simulium ornatipes*, showing form of abdomen.

## The Genus CNEPHIA End.

We were previously unable to give characters separating the larvae from *Simulium*. We find that they may be recognized by the truncated posterior end of the abdomen, the maximum width being at the seventh segment, as compared with the more fusiform abdomen of *Simulium* (Text-fig. 1). They are also more waxy and opaque in appearance, and the ventral incisure of the head capsule is shallow, contrasting with the deep incisure of all known Australasian species of *Simulium* (Text-fig. 2). The incisure is shallow in several species of *Austrosimulium* also, but that genus is distinguished by the anal sclerite, and the body is fusiform like *Simulium*.

Although its early stages are still unknown, we now consider that *C. umbratorum* (Tonn.) should be placed in the *aurantiacum* group.

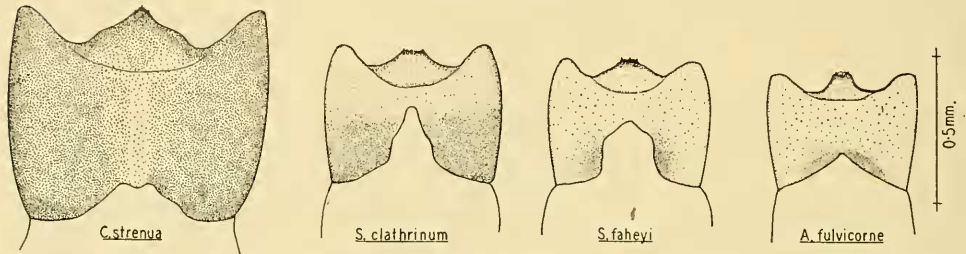
Keys to species of *aurantiacum* group.

*Adults.*

Orange to reddish brown flies;  $Cu_1$  gently curved; claws of ♀ with powerful basal tooth.

1. Wing with dark marking at fork of R ..... 2
- Wing without dark marking ..... 3
2. Scutum brown scaled, with median and dorsocentral vittae of golden scales .. *strenua* n. sp.
- Scutum uniformly covered with golden scales ..... *tonnoiri* (Drum.)\*
3. Large orange species; propleural hairs present ..... *aurantiacum* (Tonn.)
- Small to medium reddish brown species; propleural hairs absent ..... *umbratorum* (Tonn.)

\* All subspecies.



Text-fig. 2.—Head capsules of larvae, showing ventral incisure.

*Pupae.*

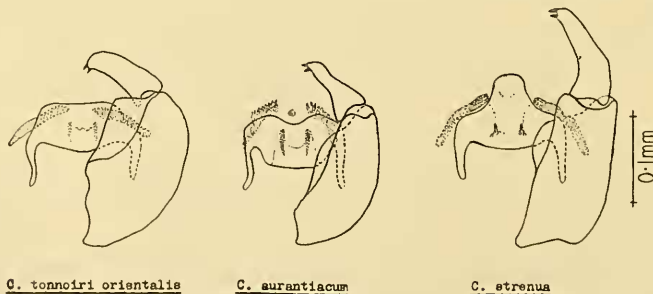
Abdomen with strong terminal hooks, chaetotaxy as in Text-fig. 4; gill filaments many-branched, arborescent.

1. Pleural membrane of abdominal segments 5-7 without chitinous plates ..... *aurantiacum* (Tonn.) *strenua* n. sp.
- Pleural membrane of abdominal segments 5-7 with rounded chitinous plates ..... 2
2. Gill filaments antler-like, about 20-40 ..... *tonnoiri tonnoiri* (Drum.)
- Gill filaments slender, in sweeping curves, about 50-70 ..... *tonnoiri orientalis* n. subsp.
- Gill filaments stout, about 15-20 ..... *tonnoiri fuscoflava* M. & M.

*Larvae.*

Abdomen truncate, widest at 7th segment; cuticle waxy, opaque; antennae short (Text-fig. 11); ventral incisure of head capsule shallow (Text-fig. 2); anal sclerite without backwardly directed strut; rectal gills simple; ventral papillae absent.

1. Proleg with prominent palp-like processes at either side of apical segment; arms of anal sclerite reduplicated ..... *strenua* n. sp.
- Proleg without such prominent processes; arms of anal sclerite single ..... 2
2. Posterior circler broad, rows closely placed, teeth light brown, small and numerous, difficult to see individually at 50 diameters ..... *aurantiacum* (Tonn.)
- Circler narrower, rows not so closely placed, teeth dark, larger, and can be seen individually at less than 50 diameters ..... 3
3. Circler with 18-24 teeth per row .... *tonnoiri tonnoiri* (Drum.) *tonnoiri orientalis* n. subsp.
- Circler with about 15 teeth per row ..... *tonnoiri fuscoflava* M. & M.



Text-fig. 3.—Hypopygia of males of *Cnephia* spp.

*CNEPHIA AURANTIACUM* (TONN.).

The characters of adults and larvae previously reported have been confirmed. In addition, the upper facets of the male eyes are smaller and more numerous than in other

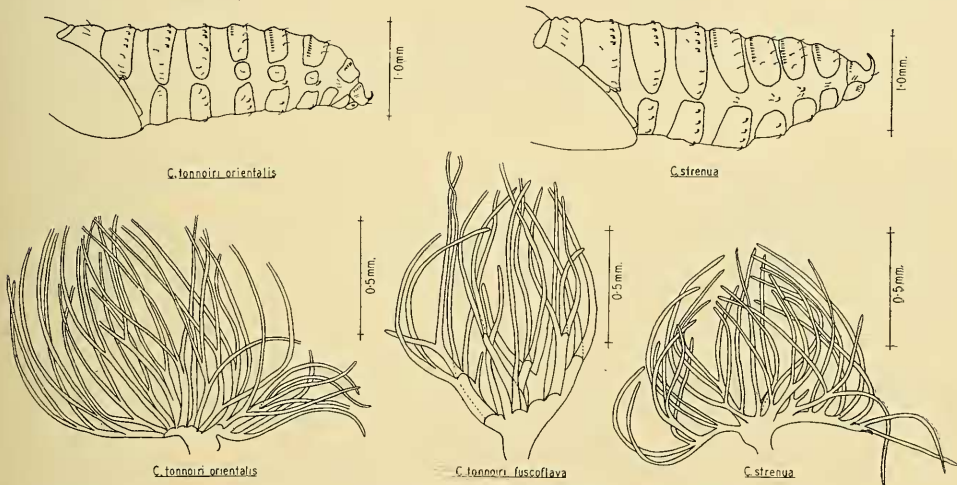
species of the genus, being about 0.04 mm. in diameter and in more than 20 rows vertically and across. The abdomen, in specimens we have seen, is less hairy than in *C. tonnoiri*. The hypopygium (Text-fig. 3) has the distal end of the anterior part of the phallosome distinctly concave and the distal end of the apodemes more heavily armed than in *C. tonnoiri*.

The posterior part of the cocoon is of more definitely "wall-pocket" shape than in the other species, but is loosely constructed anteriorly, so that the head and thorax of the pupa often hang freely from the opening.

Pupae are best separated from *C. tonnoiri* by the absence of pleural plates on abdominal segments 5-7. The gill filaments number about 30 to 40, and are stouter than in *C. tonnoiri orientalis*, with broadly angled branches, and a stiff, antler-like form; they cannot be distinguished readily from those of *C. strenua* and *C. tonnoiri tonnoiri*.

The posterior circling of the larva has a more distinctive appearance than can be indicated in words, and may be seen quite easily in unmounted specimens at the magnification indicated. The median notch in the anal sclerite is closed posteriorly, so that the body of the sclerite appears to have a hole in it (Text-fig. 5).

*New distribution.*—Queensland: South coast district. Little Nerang Creek, elevation 300 ft., August. Early stages on reeds in fairly fast, cold, clear, turbulent water; adults bred from the pupae.



Text-fig. 4.—Pupae of *Cnephia* spp. Top, abdominal chaetotaxy; below, respiratory horns.

#### CNEPHIA TONNOIRI (Drum.).

All subspecies are to be distinguished from *C. aurantiacum*: as *adults* by the dark spot on the wing, the almost invariable absence of propleural hairs, the more extensively darkened mid and hind legs, the larger upper facets of the ♂ eyes (about 0.06 mm. in diameter and in about 15 rows vertically, 12 across), and by the ♂ hypopygium (Text-fig. 3), the distal end of the anterior part of the phallosome being gently sinuous and the apodemes relatively weak; as *pupae* by possessing well defined, rounded chitinous plates on the pleural membrane of abdominal segments 5 to 7 (Text-fig. 4); and as *larvae* by the coarser posterior circling and open median notch in the anal sclerite (Text-fig. 5).

The three subspecies now recognized are distinguished from each other primarily on the pupae.

#### *Cnephia tonnoiri tonnoiri* (Drum.).

The respiratory filaments of the pupa number about 20 to 40, the main branches are a little stouter than in the eastern race, relatively stiff, with wide angle of branching

and antler-like appearance similar to *C. strenua* in Text-fig. 4 and also very like the filaments of *C. aurantiacum*.

*Distribution*.—Western Australia (localities given in previous paper).

*Cnephia tonnoiri orientalis*, n. subsp.

*Types*: Holotype ♀, allotype ♂, morphotype pupa and larva, from Little Nerang Creek, south coastal Queensland, September, in the Division of Entomology, C.S.I.R.O., Canberra, A.C.T.

*Adults*.

Indistinguishable from *C. tonnoiri fuscoflava* as originally described (Mackerras and Mackerras, 1948, p. 238). They may be darker than the typical subspecies, but the only specimens we have seen from Western Australia are rather old, and we did not previously give sufficient weight to the possibility that they may have faded. We have searched for propleural hairs on a considerable series of specimens, and found two or three weak hairs near the lower margin of the sclerite on one side only in two females. As these hairs form a well-defined group on the surface of the sclerite in *C. aurantiacum*, this character remains substantially reliable. Hypopygium of male as in Text-fig. 3.

*Cocoon*.

A shapeless bag, as in other subspecies.

*Pupa*.

Chaetotaxy and terminal spines as in other subspecies. Gill filaments about 50 to 70 in number, rather slender, branching mostly close to the base with narrow fork, more flexible than in the typical subspecies and sweeping forward in even curves (Text-fig. 4). Specimens from the type and southern localities have about 50 filaments, those from Springbrook 50 to 70, but are otherwise indistinguishable.

*Larva*.

As typical subspecies. The posterior circlet is composed of well-spaced rows of eighteen to twenty-four medium-sized teeth.

*Distribution*.—Tasmania: Rheban (Griffiths R., Sandspit R.), January. A.C.T.: Canberra, November (Tonnoir); Coree Creek, November, January (Tonnoir); Cotter R. and Paddy's R., November (Mackerras). Queensland: Little Nerang Creek (300 ft.), August, September; Purling Brook (Springbrook area), 2,000 ft., December.

*Biology*.

The early stages occur in clear, moderate to fast, turbulent streams, generally adjacent to, rather than in, the line of fastest flow. They are nearly always attached to vegetation, rarely to stones. Adults have not been collected in the field.

*Cnephia tonnoiri fuscoflava* M. & M.

The pupal gill filaments are stouter and fewer than in the other subspecies (Text-fig. 4), and there are fewer teeth in the posterior circlet of the larva. Adults are indistinguishable from *C. tonnoiri orientalis*.

*Distribution*.—Queensland: Still only known from the type locality on Stradbroke Is., our (1949) record of it from Little Nerang Creek being in error.

CNEPHIA STRENUA n. sp.

*Types*.—Holotype ♀, allotype ♂, morphotype pupa and larva, from the Cascades, Freshwater Creek, Cairns district, north Queensland, September, in the Division of Entomology, C.S.I.R.O., Canberra, A.C.T.

*Distinctive features*.

A large species. Adults resemble *C. tonnoiri*, but are distinguished by the dark antennae, scutal pattern, black hairs at sides of scutellum, differently marked legs, and less hairy abdomen. Pupae similar to *C. aurantiacum*. Larvae gigantic when full grown, with very dark head and very broad posterior circlet of very fine teeth; on each side of the distal segment of the proleg there is a conspicuous, palp-like process, which has not been seen in any other species we have examined.

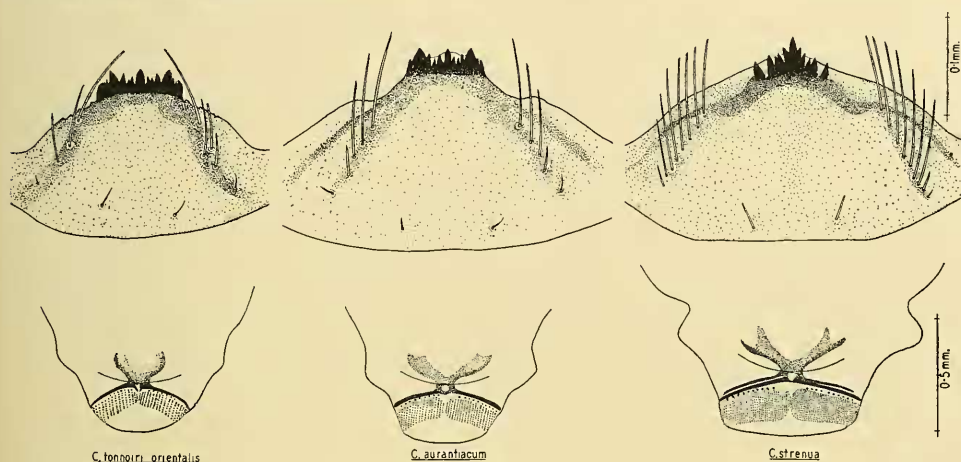
*Female*.

Length: Body 3.5 to 4 mm., wing about the same.

*Head*.—Frons about one-eleventh of head width, dark greyish brown, with fine golden hairs. Antennae with basal three segments light brown, remainder dark brown. Face and palpi brown.

*Thorax*.—Scutum rich brown, covered with brown scales showing golden reflections anteriorly and posteriorly in certain lights, and with narrow but distinct median and dorsocentral vittae of golden scales. Scutellum with conspicuous long black hairs laterally and short golden ones centrally. Pleurae yellowish brown, darker on lower part of sternopleuron. A few propleural hairs are present in all specimens.

*Legs*.—Coxae and femora yellowish, but with dark brown tips to femora. Basal quarter of tibiae yellowish, remainder dark brown. Hind metatarsus similar; other tarsal segments brown, with narrow yellow zone at base. Calcipala large, of typical form of the group; pedisulcus shallow, corrugated. Claws with strong basal tooth, as in other species of the group.



Text-fig. 5.—Submenta (above) and anal sclerites (below) of larvae of *Cnephia* spp.

*Wings*.—Hyaline, with small but distinct dark marks at base and at fork of R as in *C. tonnoiri*. Halteres large; stem creamy yellow, knob dark brown.

*Abdomen*.—Dark greyish brown dorsally, with a fringe of golden hairs near distal edge of each segment. Spermatheca nearly smooth; external genitalia and genital fork as in *C. tonnoiri*.

#### Male.

The upper facets of the eyes are about 0.06 mm. in diameter and in about 15 rows vertically, 12 across. The antennae are pale on only the first and basal half of the second segment; the scutal vittae are less well defined, and there is a rather indefinite patch of golden scales above and in front of wing roots; the legs are less darkened; otherwise as in female.

Hypopygium (Text-fig. 3) with the distal end of the anterior part of the phallosome lightly chitinized and produced into a prominent process, which at first sight resembles a median piece, but is seen on close examination to be continuous with the distal edge. There is a rather prominent, hairy lobe on the inner side of the coxite.

#### Cocoon.

Length 3–4 mm. Like *C. tonnoiri*, soft, simple bag-like; dark, and usually including foreign material. Attached to substrate all along ventral wall, generally in groups of two or more. The head and thorax of the pupa often project from the cocoon.

#### Pupa.

Length 3–4.5 mm. The respiratory organ has a short, wide stem, which divides at once into several wide branches, the posterior being the longest. Each main trunk

gives off a number of spreading, antler-like branches. Many of these divide again, forming a complex group of about 50 to 55 filaments arranged as in Text-fig. 4, in which, however, only about two-thirds of the filaments are shown.

The pupa cannot be distinguished on these and other easily seen characters from *C. aurantiacum*, but does appear to differ, in that the third abdominal sternite is more strongly chitinized and bears three instead of two hooks laterally on each side, the tergites are finely tuberculate on their posterior portions only (tuberculate all over in *aurantiacum*), and there are usually more than five stiff hairs on each side of the ninth tergite (five in *aurantiacum*). The first of these characters may be variable, and the others can only be seen in cleared and mounted material.

#### Larva.

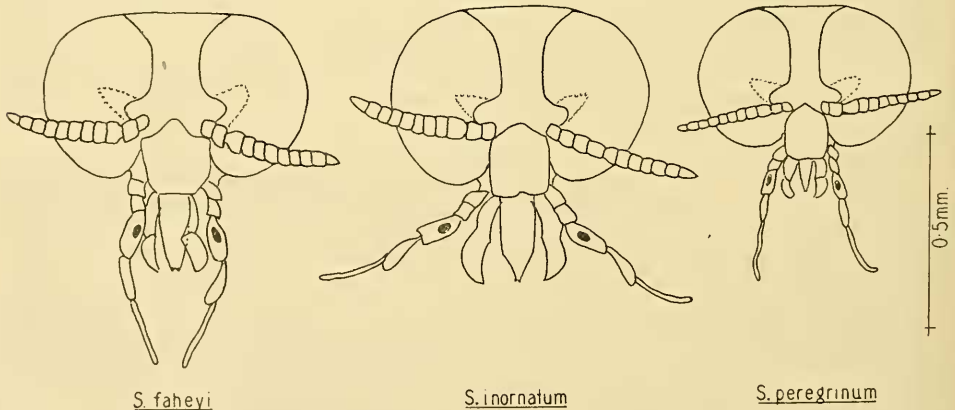
Length of gill-spot larvae 8–11 mm. Very large, thick, brownish larvae, with paler integument ventrally at posterior end. Head capsule and its appendages very heavily pigmented, dark brown to black, obscuring pattern on dorsum of head. Submental plate characteristic, with prominent central tooth and eight or nine pairs of stout, blade-like spines on each side (Text-fig. 5). Gill-spot as in Text-fig. 14. Thoracic proleg robust and armed with a conspicuous circlet of dark hooks, which are more closely set than in other known species; the lateral cuticular plates are well developed and bear numerous long spines, and there are two pointed palp-like processes at the base of the apical narrower portion of the proleg (Text-fig. 14).

Anal sclerite with median notch closed posteriorly to form a "hole"; its posterior limbs double. There is a conspicuous row of 10–12 tubercles bearing short spines on each side between the posterior limb of the sclerite and the upper edge of the circlet, and also a patch of fine, short hairs on each side above the posterior limbs. Posterior circlet exceptionally well developed, the rows of hooks being so closely packed and the hooks so numerous as to render counting them impracticable. Individual hooks are rather smaller than in *C. tonnoiri*, and are also smaller than the hooks on the proleg.

*Distribution.*—Known only from the type locality in North Queensland.

#### Biology.

This is a remarkable species. The larvae are enormous, so large that we scarcely believed that they were Simuliid larvae when we first saw them; yet their bulk must be made up of muscle and essentially larval organs, for the pupae and adults are little if



Text-fig. 6.—Heads of females of *Simulium* spp.

any bigger than their near relatives. Most larvae were found in cascades, at points where a powerful jet of water was concentrated between narrow walls of rock and shooting over a sharp ledge. The depth of water was about twelve inches, and the flow so strong that an arm or leg could only be held against it with the greatest difficulty. The larvae were clustered thickly on the bottom ledge, where the flow was strongest. It is from their adaptation to withstand such a battering that the specific

name is derived. By contrast, a few were also found in company with *Simulium aureonigrum* in a small tributary, on a nearly vertical face of rock over which the water poured in a thin, fast layer. When removed from the water, the larvae adhered to our hands in a way we had not seen previously, and were quite difficult to remove.

Pupae were in groups on the rocks, in rougher, more sheltered places below the brink, where the water spread out fanwise into a fast, but much thinner and less forceful layer. They were quite difficult to collect intact. No adults were seen in the field.

The Genus *SIMULIUM* Latr.

So many species have been added that our previous keys have become obsolete.

Keys to Species.

Females.

- 1 Pre-alar area bare ..... 2
- Pre-alar area with conspicuous pale scales ..... 3
- 2. Medium-sized species; legs conspicuously marked with black and yellow ..... *ornatipes* Sk.
- Small species; legs predominantly dark (basal two-thirds of hind metatarsus pale) ..... *peregrinum* n. sp.
- 3. Minute, pale species; antennae entirely yellowish fawn; femora and tibiae predominantly creamy yellow. (Northern Territory.) ..... *Simulium* sp. B.
- Larger, darker species; antennae with at most the basal segments pale; femora and tibiae predominantly dark ..... 4
- 4. Scutum with golden median and dorsocentral lines; abdomen with tergites 2-4 black scaled; 5-8 bare, greyish black, rather shining ..... *clathrinum* M. & M.
- Scutum without discrete golden lines; abdomen with pale scales on some tergites, including 5-8 ..... 5
- 5. Basal segments of antennae brown; very dark species ..... 6
- Basal segments of antennae orange to brownish yellow; not such dark species ..... 7
- 6. Scutum and second abdominal tergite adorned with rich golden scales; tergites 3-5 entirely dark, 6-8 sprinkled with creamy gold scales ..... *aureonigrum* n. sp.
- Scutum and second abdominal tergite with dull golden to silvery scales; tergites 3-7 with incomplete golden or creamy fringe and few or no pale scales on the disc, 8 with a few scattered pale scales ..... *inornatum* n. sp.
- Scutum and second abdominal tergite with creamy gold to silvery scales; tergites 3-5 with a few apical silvery scales, 6-8 speckled with silvery scales ..... *melatum* Wh.
- 7. Brownish black and golden species; second abdominal tergite with at most an incomplete golden fringe; claws with small, sub-basal tooth ..... *faheyi* Tayl.
- Brownish black and creamy gold species; second abdominal tergite quite densely covered with creamy gold scales; claws with small, sub-basal tooth ..... *papuense* Wh.
- Black and silvery species; second abdominal tergite with median patch or apical band of silvery scales; claws without teeth ..... *nicholsoni* M. & M.

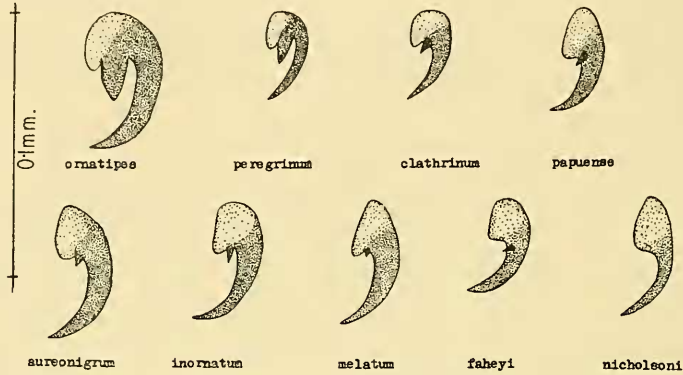
Notes.—(1) We have omitted two New Guinea species, *S. oculatum* End. and *S. wilhelmlandae* Smart, because it is uncertain to which groups they belong; the former may be close to *S. clathrinum*, the latter to *S. peregrinum*. (2) The claw characters are useful, but can only be seen properly in cleared and mounted preparations. Females of *S. ornatipes* and *S. peregrinum* have very large basal teeth on the claws, *S. clathrinum* has medium-sized teeth, often detectable in pinned specimens, *S. aureonigrum*, *S. inornatum*, *S. faheyi* and *S. papuense* have small sub-basal teeth, *S. melatum* has minute teeth deeply set in the concavity of the claw, and *S. nicholsoni* has none (Text-fig. 7).

Males.

- 1. Pre-alar area bare ..... 2
- Pre-alar area with conspicuous pale scales ..... 3
- 2. Medium-sized species; upper facets of eye less than 0.04 mm. in diameter, in about 16 rows; legs conspicuously marked with black and yellow ..... *ornatipes* Sk.
- Small species; upper facets of eye more than 0.05 mm. in diameter, in 10 rows; legs predominantly dark ..... *peregrinum* n. sp.
- 3. Upper facets of eye more than 0.04 mm. in diameter, in about 12 rows ..... 4
- Upper facets of eye less than 0.04 mm. in diameter, in about 16 rows ..... 6
- 4. Abdominal tergites 2 and 5-8 with golden scales arranged much as in ♀ ..... *papuense* Wh.
- Abdominal tergites 2-8 velvety black, tomentose ..... 5
- 5. Scutum with three golden lines usually discernible ..... *clathrinum* M. & M.
- Scutum without indication of median and dorsocentral golden lines ..... *aureonigrum* n. sp.

- 6. Anterior part of phallosome with straight or gently sinuous distal edge ..... *nicholsoni* M. & M. *faheyi* Tayl.
- Anterior part of phallosome with markedly concave distal edge ..... 7
- 7. Anterior part of phallosome forming an open bay distally ..... *melatum* Wh.
- Anterior part of phallosome with bay almost enclosed distally ..... *inornatum* n. sp.

Note.—The abdominal adornment of *S. papuense* is most unusual. Our specimen may be an intersex, but the eyes, legs and genitalia are normal, and Wharton's description of the allotype agrees.



Text-fig. 7.—Claws of females of *Simulium* spp.

*Pupae.*

- 1. Gill filaments numerous, arborescent ..... *papuense* Wh.
- Gill filaments 8 on each side ..... *peregrinum* n. sp.
- Gill filaments 6 on each side ..... 2
- Gill filaments 4 on each side ..... 3
- 2. Respiratory organ with well-marked stem; filaments directed forward close together ..... *nicholsoni* M. & M.
- Respiratory organ with short stem; filaments spreading more widely ..... *faheyi* Tayl.
- 3. Cocoon with deep collar; filaments narrow, subequal, directed forward close together ..... *clathrinum* M. & M.
- Cocoon with narrow collar or none ..... 4
- 4. Filaments very thick, pale, relatively smooth, subequal, spreading widely .... *ornatipes* Sk.
- Filaments of moderate thickness, darker, irregularly mammillated, subequal, directed forward close together ..... *melatum* Wh.
- Filaments of intermediate thickness, dark, finely patterned, of unequal length, spreading widely ..... *inornatum* n. sp.
- Filaments narrow, dark, finely patterned, subequal, spreading ..... *aureonigrum* n. sp.

*Larvae.*

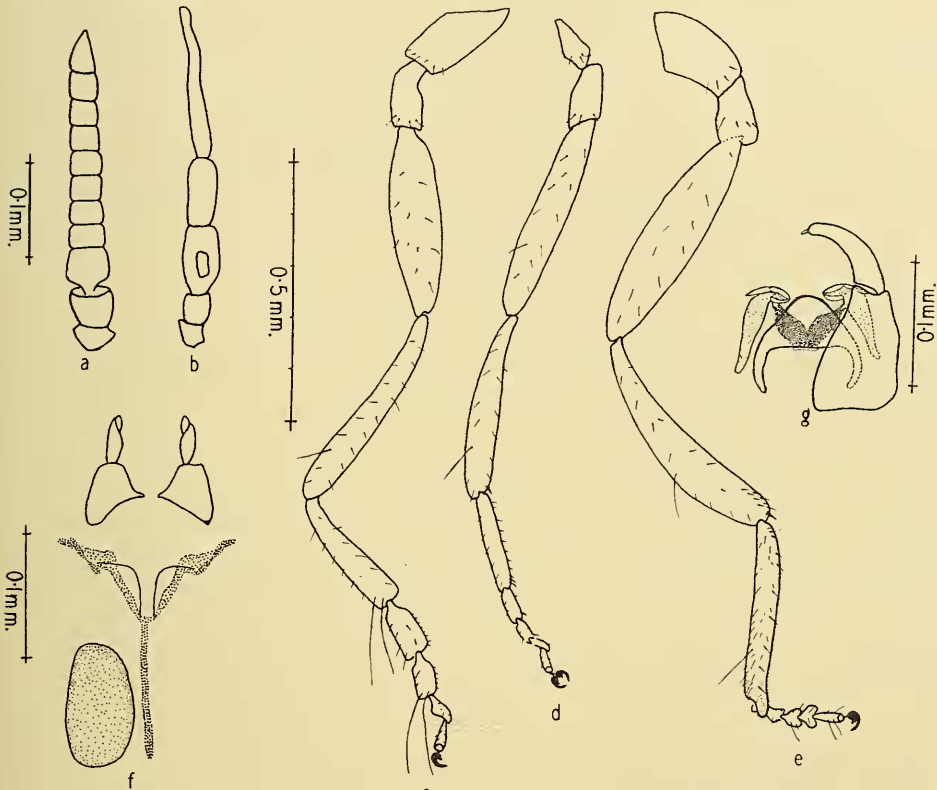
- 1. Rectal gills simple ..... 2
- Rectal gills compound ..... 5
- 2. A broken line of brown scales ventro-laterally on each side anterior to the circle ..... 3
- No brown scales in this position ..... 4
- 3. Posterior part of head rather uniformly pigmented; ventral papillae usually indefinite or absent ..... *melatum* Wh.
- Posterior part of head with a W-shaped pattern; ventral papillae well defined ..... *inornatum* n. sp.
- 4. Smaller, more yellowish larvae; head pattern negative type ..... *nicholsoni* M. & M.
- Larger, darker larvae; head pattern positive type ..... *ornatipes* Sk.
- 5. Small larvae; antennae conspicuous, nearly as long as head ..... *peregrinum* n. sp.
- Larger larvae; antennae inconspicuous, about half as long as head ..... 6
- 6. A broken line of brown scales ventro-laterally on each side anterior to the circle ..... *aureonigrum* n. sp.
- No brown scales in this position ..... 7
- 7. Head pattern indefinite or partly negative in type; ventral incisure extending about half-way to base of submentum ..... *faheyi* Tayl.
- Head pattern positive type; ventral incisure extending more than half-way to base of submentum ..... 8
- 8. Ventral incisure reaching base of submentum; head pattern conspicuous, bullet-shaped ..... *papuense* Wh.
- Ventral incisure not reaching base of submentum; head pattern cruciate .. *clathrinum* M. & M.



*Notes.*—(1) The ventro-lateral scales at the posterior end of the abdomen are sometimes inconspicuous or absent in young larvae of *S. melatum*. (2) The ventral papillae do not provide such clear-cut distinctions as in *Austrosimulium*. They are large in *peregrinum*, medium to small in *ornatipes*, *nicholsoni*, *faheyi*, *aureonigrum* and *inornatum*, indefinite or ventro-lateral in *melatum* and *papuense*, and absent (though ventro-lateral swellings are present) in *clathrinum*.

*SIMULIUM ORNATIPES* Sk.

*New distribution.*—Queensland: Springbrook, 2,000 ft. (south coast district), December; various coastal streams between Nambour and Gympie, February, April, May; Babinda, N.Q., September (the most northerly record so far on the mainland).



Text-fig. 8.—*S. peregrinum*. ♀: a, antenna; b, palp; c, fore leg; d, mid leg; e, hind leg; f, genitalia. ♂: g, hypopygium.

*SIMULIUM PEREGRINUM* n. sp.

*Types:* Holotype ♀, allotype ♂, morphotype pupa and larva, from Black Camp Creek, Cape York, August, in the Division of Entomology, C.S.I.R.O., Canberra, A.C.T.

*Distinctive features.*

A very small species, lacking pre-alar scales, but possessing lower sternopleural ("mesosternal") hairs and largely pale hind metatarsus like the *clathrinum* group. Adults with base of abdomen creamy to yellowish in both sexes; head of male wider than thorax, upper facets of eye greatly enlarged. Pupae with respiratory apparatus longer than the body, dichotomously branched, forming eight slender filaments. Larvae with very prominent ventral papillae, compound anal gills, and antennae which are nearly as long as the head.

This is the first species of Edwards' sub-group C to be found on the mainland of Australia. It is typical of the sub-group in all respects, and quite distinct from the

*clathrinum* group, though it shows features which suggest that the latter may have evolved from the former in the isolation of their Australasian extension. Similarly, *S. ornatipes*, which lacks lower sternopleural hairs, would appear to represent the sub-group D in a somewhat modified form in this region.

*S. peregrinum* is separable from the species of sub-group C described by Edwards from Java most conspicuously on pupal characters, and from *S. wilhelmlandae* Smart. (= *Morops pygmaea* End.) by the colouration of the antennae and abdomen. Its name is derived from the fact that it is, in a sense, a wanderer from the home of its relatives.

#### *Female.*

Length: Body 1.5 mm.; wing 1.4 mm.

*Head* wide and rounded. Frons about one-sixth of head width (Text-fig. 6) brownish black, shining. Antennae eleven-segmented; basal three or four segments brownish yellow, remainder dark brown. Proboscis very short, so that the palpi appear to be long; both dark brown, with the terminal segment of the palp paler.

*Thorax.*—Scutum and scutellum uniformly greyish black, rather shining; disc thinly and evenly covered with short, fine, golden hairs, which are rather denser and stronger at the sides and on the scutellum; apical edge of scutellum with a row of long black hairs. Pleurae uniformly dark greyish brown. Pre-alar area bare; a tuft of white propleural hairs present; lower sternopleural hairs fine, pale, and rather scattered.

*Wings* clear, veins brownish yellow, hairs black. There is the usual row of spinules on the costa and a few on the distal part of R; upper surface of R with a single row of black hairs. Halteres with stem light brown, knob pale lemon yellow.

*Legs* (Text-fig. 8).—Fore tarsi larger and more powerful than mid, distinctly thickened but not flattened; the enlargement is more obvious than in the *clathrinum* group. Hind femora and tibiae swollen, about twice as thick as fore or mid, the tibiae angulated beyond the middle posteriorly. Calcipala and pedisulcus well developed. All claws with a powerful basal tooth.

Fore and mid coxae cream; femora brown, covered with golden scales on most of anterior surface; tibiae brown, with creamy knees and golden scales on about proximal third; tarsi deep brown, almost black. Hind coxae brown, cream apically; femora brown, with rather scattered pale golden scales; tibiae brown, with creamy knees and a covering of pale golden scales on basal half anteriorly; metatarsi cream and covered with creamy golden scales on basal four-fifths, brown on distal fifth; remaining tarsal segments dark brown, but with a ring of pale scales at bases of second and third segments.

*Abdomen.*—First tergite brown, creamy in centre and with a creamy fringe; second largely cream, but more or less narrowly brown along apical edge; 3 to 5 brownish black, tomentose, with dark hairs; 6 to 8 black and shining. Venter cream basally, light brown apically. Terminalia, genital fork and spermatheca as in Text-fig. 8.

The female from Smoko Creek is a little larger; tergites 1 and 2 of its abdomen are more completely yellow; only the basal three-fourths of the hind metatarsi are pale; but otherwise it is similar to the Cape York specimens. It came from an exactly similar pupa.

#### *Male.*

Head large, rounded, wider than thorax. Upper facets of eye about 0.05 mm. in diameter,\* in ten rows vertically and transversely. Antennae creamy yellow, except for the distal 2 to 4 segments, which are darkened. Scutum fairly densely covered with creamy gold scales, which are larger and more conspicuous than in the female. Pleurae, wings and legs as in female; claws simple, of typical male form. Abdomen with first tergite dark brown, with long brown fringe; second mostly yellow, with apical brown zone widening at sides, the pale part covered with rather shining tomentum; remaining segments velvety black, except for conspicuous, silvery, tomentose sublateral patches on 5 to 7; venter as in female.

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\* Eye facet measurements given in this paper were made on cleared preparations mounted in Canada balsam.

Hypopygium (Text-fig. 8) with style shorter than coxite, ending in a single spine. Anterior part of phallosome strongly convex and longitudinally striate ventrally; posterior part with a pair of heavily chitinized, deeply pigmented, somewhat irregular plates, possibly corresponding to the chitinized bars in *Cnephia*. Apodemes large and powerful, terminating in a beak-like structure with three divisions. No median piece detected.

#### *Cocoon.*

Wall-pocket type; smooth, very thin and delicate; no collar and no central dorsal projection.

#### *Pupa.*

Length: Body 2.1 mm., filaments 2.2 mm.

There is a group of four long hairs on each side of the scutum just anterior to its highest point; abdominal armature weak, inconspicuous, of normal distribution, except for the presence of patches of minute spines on the ventral surface of segments 4 to 6. Respiratory apparatus (Text-fig. 10) with a distinct stem, branching dichotomously to form eight very long, slender filaments; the lower and outer pairs are longer than the upper and inner. The tips of these delicate filaments break off easily, so that discrepancies in their relative lengths are seen in different specimens.

#### *Larva.*

Small; length of gill-spot larva about 3.7 mm.

Head pattern (Text-fig. 11) of positive type, rather indefinite; generally of broadly rectangular form, with a somewhat darker median zone merging into a darkened, transverse, posterior triangle. Antennae very large, more than three-fourths the length of the head; basal segment longer than apical, and without apparent subdivision into two parts. Submentum as in Text-fig. 12.

Gill-spot brown, characteristic, the long stem and posteriorly coiled filaments being easily seen (Text-fig. 14).

*Abdomen.*—Ventral papillae triangular, very large and conspicuous. Rectal gills compound, each with about four lobes. Posterior circlet narrow, rows well spaced, each composed of 12 rather large teeth. Anal sclerite as in Text-fig. 12. There are no ventro-lateral dark scales in front of the circlet.

*Distribution.*—North Queensland: Cape York (Black Camp Creek, Black Gin Creek), August, September; Russell River, near Babinda, and Smoko Creek, near Bramston Beach, September.

#### *Biology.*

In the type locality larvae were abundant on reeds, sticks, and dead leaves in the swifter parts of small, clear, shaded creeks running through fairly dense bush. Pupae were present in the same situations, but only a few could be found, although gill-spot larvae were not uncommon. Conditions in Smoko Creek were similar to those on Cape York, but the Russell River was a swifter, more open stream. Adults were not seen in the field.

#### SIMULIUM CLATHRINUM M. & M.

Adults, pupae and larvae from North Queensland resemble those from the south, but the cocoons (Text-fig. 15) differ in that, although they have the same lattice-like construction and well-developed collar, the mouth has a clearly defined, often thickened edge, which gives it something the appearance of an *A. bancrofti* cocoon under a hand lens. Many pupae in the Babinda district had the filaments broken off short, and none of these gave rise to adults.

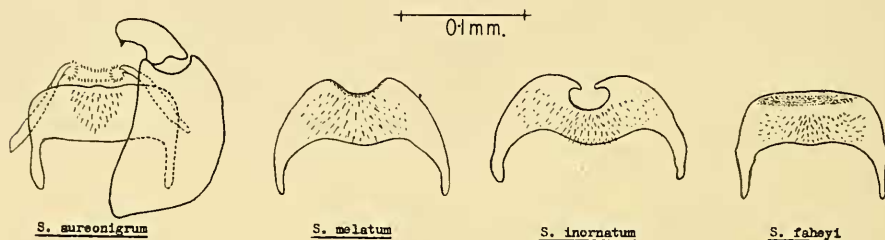
*New distribution.*—Queensland: Currumbin Creek, near N.S.W. border, January; swifter coastal streams between Nambour and Gympie, February, April, May (southern race). Cape York, Black Gin Creek, August; Babinda district, abundant in larger, swifter streams and also in a small jungle creek near Bramston Beach, September; Innisfail district, Berner Creek, September (all these being northern race).

## SIMULIUM AUREONIGRUM n. sp.

*Types*: Holotype ♀, allotype ♂, morphotype pupa and larva, from a small tributary near the Cascades, Freshwater Creek, Cairns district, October, in the Division of Entomology, C.S.I.R.O., Canberra, A.C.T.

*Distinctive features.*

Five Australian species of *Simulium* are now known to have pupal respiratory organs with four filaments. *S. ornatipes* stands apart on group and general characters, and *S. clathrinum* is well differentiated in all stages, but the other three (*aureonigrum*, *melatum*, *inornatum*) are closely related. They are dark species, with more rounded heads than *S. nicholsoni* and *S. faheyi* (Text-fig. 6), and with larvae having ventrolateral patches of brown scales just in front of the posterior circlet, suggesting at first sight a rudimentary form of the ventral chitinous ring found in some species of *Austrosimulium*.



Text-fig. 9.—♂ hypopygium of *S. aureonigrum*; anterior part of phallosome of other species.

*S. aureonigrum* is distinguished from its near relatives: in the female by the rich golden scales on the jet black scutum and by the arrangement of the golden scales on the abdomen; in the male by the large upper facets of the eyes and gently sinuous distal margin of the anterior part of the phallosome, in both of which respects it is nearer to *S. clathrinum*; in the cocoon by its close weave and lack of a central dorsal projection; in the pupa by the form and arrangement of the gill-filaments (Text-fig. 15); and in the larva by the compound rectal gills.

*Female.*

Length: Body 2.3 mm., wing 2.3 mm.

*Head*.—Frons about one-fifth of head width, tapering towards antennae; grey, with scattered golden scales. Face grey, with some pale scales. There is a rim of golden scales on the occiput behind the eyes. Antennae with first two segments light brown, remainder brownish black. Proboscis dark brown, palpi brownish black.

*Thorax*.—Scutum black, fairly densely covered with rich golden scales, mixed on the disc with some patchily distributed black ones. The black scales also form fairly definite, narrow dorsocentral lines, which converge slightly from behind forward and then diverge for the anterior fourth of their length as in *S. nicholsoni*. Pleurae uniformly dark grey, with paler grey reflections in certain lights. Pre-alar scales rich to creamy gold; pronotal, propleural and lower sternopleural scales pale gold.

*Legs*.—Fore and mid coxae covered with golden scales, hind coxae black. Femora black, with rather irregularly distributed golden scales. Tibiae black, with paler gold (silvery in certain lights) scales on basal half, extending more distally on outer surface. Fore and mid tarsi black. Hind metatarsus with creamy zone on basal two-thirds; remaining segments completely dark. Calcipala and pedisulcus as in *S. clathrinum*. Claws with a small sub-basal tooth.

*Wings* hyaline, veins dark. Halteres with brown stem and creamy yellow knob.

*Abdomen*.—First segment dark brown laterally, paler medially, with a deep golden fringe. Second deep brown, blackish at apex, and bearing a conspicuous median patch of rich golden scales, which extend laterally as an apical golden line to join the golden patches on the side of the abdomen. Third to fifth entirely black dorsally. Sixth with

a smooth, somewhat tomentose area in centre, seventh and eighth entirely smooth, not as shining as *S. clathrinum*; all three bearing scattered golden scales, especially near their apical edges. Side of abdomen with broad patches of rich golden scales on segments 2 to 5, a few on 6, and only two or three on 7. Venter dull yellowish brown. External genitalia and genital fork as in other species of the group.

#### Male.

Upper facets of eyes as in *S. clathrinum*, averaging 0.042 mm. in diameter and in about 12 rows vertically and across. The antennae are entirely dark. The scutum is jet black, fairly densely covered with rich golden scales, which are somewhat irregularly mixed with black ones in the central area, though with no indication of definite lines. The legs are similar to the female, except that the zone of pale scales on the hind tibia is more sharply limited distally, and the pale area on the hind metatarsus is rather vague and indefinite.

Abdomen dark brown to black, with apex of first segment lighter brown; second to fourth covered with velvety black tomentum, remainder with velvety black tomentum in centre, somewhat shining at sides, where there are silvery reflections in certain lights. Venter with basal two or three segments dull yellowish brown, remainder dark. Hypopygium similar to that of *S. clathrinum*.

#### Cocoon.

Length about 2.7 mm. along base. An open wall-pocket type, smooth and fairly closely woven; with a well-defined, darkened, rolled edge, but without collar or central dorsal projection.

#### Pupa.

Length 2.5 mm. Cephalic and thoracic hairs slender. Head and thorax densely covered with minute, irregularly arranged tubercles, which become more triangular and spiny on the under side of the head, legs and wing covers. Respiratory organ (Text-fig. 15) with a very short stem, which is covered with minute triangular spines. The four filaments come off almost simultaneously; the first sweeps upwards and directly forwards; the second upwards, inwards and forwards; the third downwards, inwards, forwards and upwards; and the fourth downwards, outwards, forwards and finally curves upwards and inwards. Abdominal chaetotaxy normal.

#### Larva.

Length 5 to 6 mm. when full grown. Body white to slaty grey in colour, with the usual darker mottling. Antennae about half the length of the head, projecting a little beyond basal segment of mouth brushes. Head pattern positive type, usually forming a well-defined "W" as in Text-fig. 11, but sometimes rather diffuse. Ventral incisure deeper than wide, extending about half-way to base of submentum, and forming a rounded triangle anteriorly. Submentum as in Text-fig. 12; five pairs of hairs on submental plate.

Gill-spot (Text-fig. 14) L-shaped, with three main trunks showing in the anterior, upright limb, which is shorter than the horizontal limb.

Ventral papillae present, small and triangular, rather better defined than in related species. Rectal gills compound; accessory lobes variable, usually three on each main lobe, but sometimes fewer and occasionally none on one or two lobes. Anal sclerite as in Text-fig. 12. Posterior circling composed of about 90 rows of hooklets, with about 12 hooklets per row. There are two patches of flat, brownish scales ventro-laterally on each side just anterior to the circling.

*Distribution.*—Known only from the type locality in north Queensland.

#### Biology.

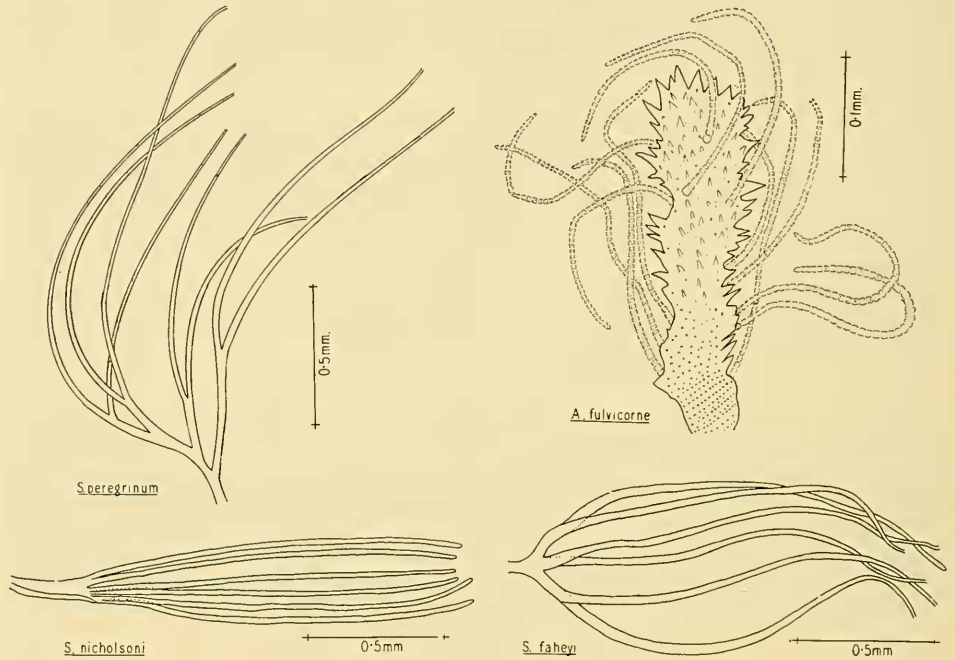
Larvae and pupae were found adhering to rock and dead leaves, in company with a few *Cnephia strenua*, in a thin layer of clear water coursing rapidly over an almost vertical face of rock. The stream was quite small and well shaded, in contrast to the powerful, turbulent flow in the adjacent, larger, open Freshwater Creek, where *C. strenua* was abundant but no *Simulium* larvae were found. Adults were not seen in the field.

Many of the larvae were parasitized by Mermethid worms, which sometimes almost filled the posterior swollen part of the abdomen of the host. In one larva a Microsporidian occupied much of the hinder part of the abdomen.

*SIMULIUM MELATUM* Wh.

Wharton, 1949, p. 406; from Blue Mountains and Sydney district, N.S.W. (type locality Lett River, Hartley).

Our material agrees substantially with Wharton's description and with specimens he kindly presented to the Institute, though with minor differences.



Text-fig. 10.—Respiratory organs of pupae.

*Female.*

Black and creamy gold to silvery, as compared with the black and rich gold of *S. aureonigrum*. The dorsum of the abdomen shows a silvery fringe to first segment, 2 with a conspicuous patch of silvery scales, 3 to 5 black, with an occasional apical silvery scale, 6 to 8 smooth, slightly shining, and speckled with silvery scales. The pale area on the hind metatarsus is better defined than in Wharton's description. Claws with a very small tooth, which is deeply set in the concavity (Text-fig. 7).

*Male.*

The upper facets of the eyes, as Wharton points out, are relatively small, resembling those of *S. nicholsoni* rather than *S. clathrinum*; they average 0.033 mm. in diameter and are in about 16 rows. The abdomen is covered with velvety black tomentum, with the usual ashy reflections from the shiny lateral patches on segments 5 to 7. The hypopygium is distinguished by the deep but widely open bay in the distal end of the anterior part of the phallosome (Text-fig. 9). This is a true indentation, and its appearance is different from that of the arched anterior part when seen more or less end on.

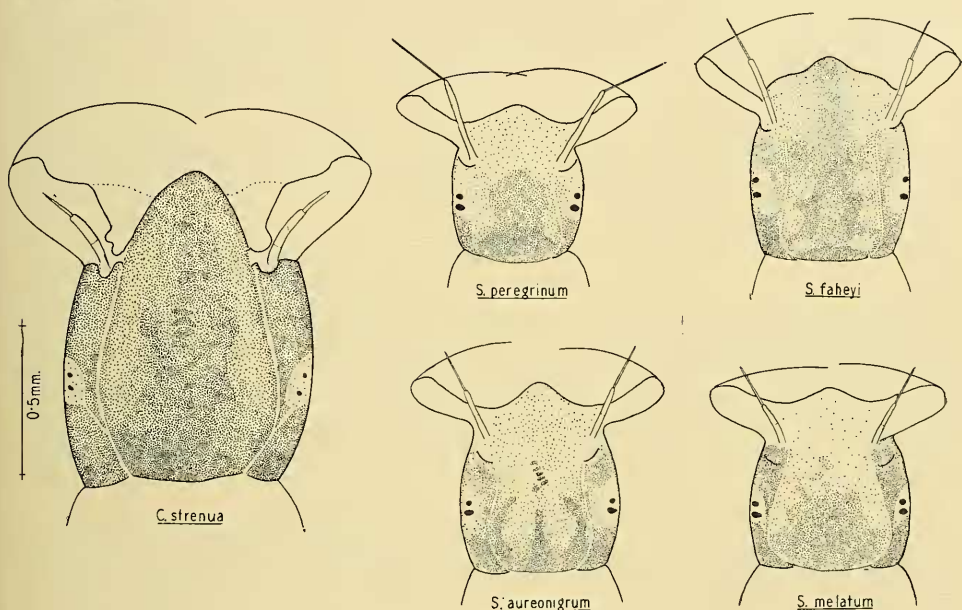
*Cocoon and Pupa.*

As described by Wharton; the cocoon has a well-marked central dorsal projection and is coarsely woven.

*Larva.*

Difficult to separate from *S. aureonigrum* and *S. inornatum*. The head pattern is generally more diffuse, and the antennae and bases of the mouth-brushes are shorter relative to the length of the head. The gill-spot is bigger in all dimensions (Text-fig. 14). Ventral papillae variable, usually none, but sometimes as well developed as in *S. inornatum*. The rectal gills are simple. A single group of flat brown scales is present ventro-laterally on each side in front of the circlet in grown larvae, but sometimes cannot be seen in young specimens.

*New distribution.*—New South Wales: Gara River, Armidale district (about 3,000 ft.), May, A. F. O'Farrell. Queensland: Purling Brook (2,000 ft.), Springbrook area, December, larvae and pupae at the edge of a fast, clear stream in company with *Cnephia tonnoiri orientalis*, *S. ornatipes*, *Austrosimulium mirabile*, *A. furiosum* and *A. victoriae*; tributary of Freshwater Creek, Cairns district, October, in company with *S. aureonigrum* (two pupae, from one of which a ♀ emerged).



Text-fig. 11.—Heads of larvae.

## SIMULIUM INORNATUM n. sp.

*Types:* Holotype ♀, allotype ♂, morphotype pupa and larva, from a small unnamed creek at 1,300 ft. on the Springbrook Road, south Queensland, December, in the Division of Entomology, C.S.I.R.O., Canberra, A.C.T.

An undistinguished species, intermediate in many respects between *S. aureonigrum* and *S. melatum*, but sufficiently distinct on characters of the male and pupa to be regarded as a separate species.

*Female.*

Head, thorax, legs, wings and halteres generally as in *S. melatum*, but with more of a tendency to a dull gold coloration. Scutum with broad though rather indefinite black dorsocentral stripes, which widen posteriorly almost to reach the median line and lateral margins. Claws with a small sub-basal tooth. First segment of abdomen with a conspicuous creamy fringe; second with a patch of golden scales on tergite; third to fifth with brownish black scales on disc and irregularly scattered creamy golden ones along the apical edge; sixth rather shiny in centre, seventh and eighth rather shiny over whole dorsum, all three bearing some dull golden scales which are mainly apical in position; the lateral patches on segments 2 to 5 are silvery.

*Male.*

Velvety black and golden, as in the other species, and with the usual lateral ashy patches on the abdomen. Resembles *S. melatum* in the upper facets of the eyes, being only moderately enlarged and in about 16 rows. Distinguished from all Australian species of the genus by the hypopygium, the anterior part of the phallosome being deeply excavated distally to form a nearly circular bay, which is almost closed by inwardly projecting arms (Text-fig. 9).

*Cocoon.*

Wall-pocket type; rather finely woven, with no collar, a rolled anterior edge, and a well-marked central dorsal projection.

*Pupa.*

Length about 3 mm. Head and thorax covered with minute tubercles. Chaetotaxy normal. Respiratory organ (Text-fig. 15) with short dark stem which gives rise simultaneously to four diverging filaments of unequal length, the ventral and ventro-lateral branches being the longest. The filaments are stiff, and curve forward and upward; the tips may be produced into a very delicate flexible extension which is readily broken off.

*Larva.*

Resembles *S. aureonigrum* in all respects, except that the rectal gills are simple, and the gill-spot is larger, though not as broad as that of *S. melatum*. From the latter it is distinguished by the more definitely W-shaped head pattern, somewhat longer antennae, and well-defined ventral papillae.

*Distribution.*—Only known from the type locality in south Queensland.

*Biology.*

Larvae and pupae were present in moderate numbers on rock, dead leaves, and the fine roots of a semi-aquatic plant in a small, steep, shady creek. The water was clear and moderately fast, but only an inch or so deep and a foot or so wide. The stream appeared to be drying out fairly rapidly. In the previous year we had taken a few larvae and pupae (which failed to emerge) about two miles lower down the same road at an elevation of 900 ft. They were in a similar creek, but on an edge of rock where the water poured over in a miniature fall.

## SIMULIUM NICHOLSONI M. &amp; M.

*New distribution.*—Queensland: Several coastal streams between Nambour and Gympie. The most northerly limits known for *S. nicholsoni* are the Mackenzie River inland and just south of Fraser Island on the coast.

## SIMULIUM FAHEYI Tayl.

*Types:* Taylor's type ♀ is in the School of Public Health and Tropical Medicine, Sydney. We have designated an allotype ♂ from Lennon's Creek, near Babinda, N.Q., and morphotype pupa and larva from Berner Creek, and lodged them in the same collection. Additional specimens (♀, ♂, pupa, larva) are in the Division of Entomology, C.S.I.R.O., Canberra, A.C.T.

The status of this species is established on the basis of fresh material from Taylor's type locality, and a re-examination of the holotype, which was kindly lent us by Mr. D. J. Lee of the School of Public Health and Tropical Medicine, Sydney, who also permitted us to mount a leg. It is close to *S. nicholsoni*, but the differences in the female, pupa and larva are sufficient to warrant specific separation.

*Female.*

*S. faheyi* differs from *S. nicholsoni* in possessing a small sub-basal tooth on the claw (Text-fig. 7), so doubtful specimens can be identified by clearing and mounting a leg. Its general coloration is brownish black (darker in fresh material than in the type, which is thirty years old) and golden, as compared with the black and silvery coloration of *S. nicholsoni*. On the abdomen, the fringe of the first segment is golden; the dorsum of the second is usually entirely brown, but sometimes with a more or less incomplete golden fringe; third and fourth entirely brown; sixth to eighth tomentose and sprinkled with brown and pale golden scales, which are not so numerous and conspicuous (nor as pale) as in *S. nicholsoni* or *S. papuense*. Other differences are listed in the key. It is



interesting that *S. papuense*, which has very different pupae and larvae, resembles *S. faheyi* so closely in the female.

*Male.*

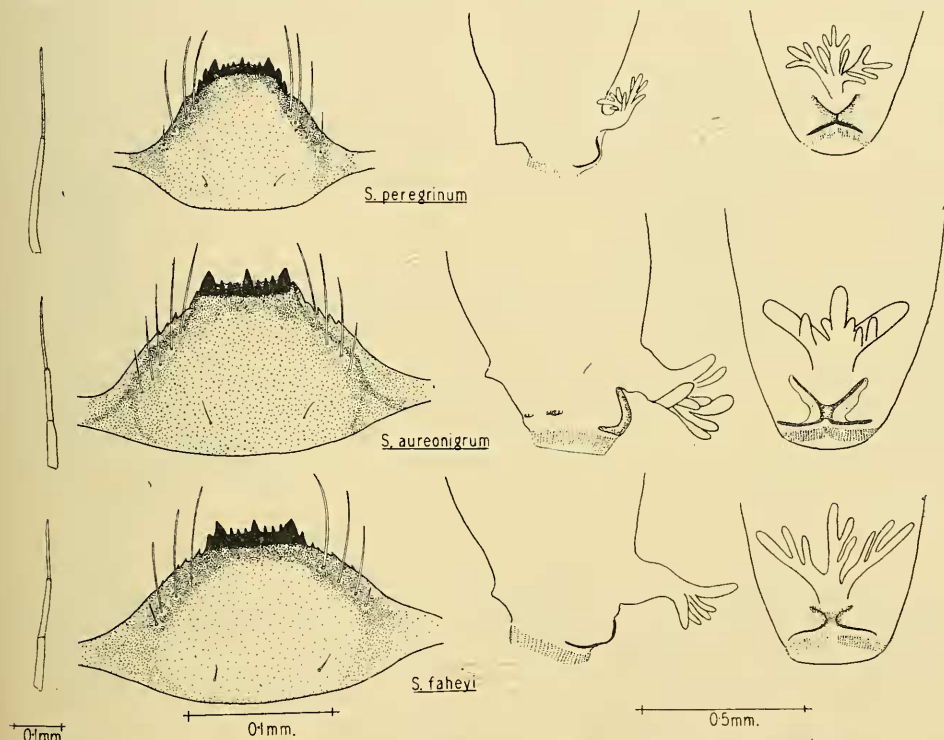
Similar to *S. nicholsoni* in all respects, including the hypopygium.

*Cocoon.*

Wall-pocket type, similar to *S. nicholsoni*, though usually more coarsely woven.

*Pupa.*

Northern specimens have the head and thorax fairly densely but not quite uniformly covered with small, blunt tubercles, like *S. nicholsoni*, and the thoracic and abdominal chaetotaxy also resembles *S. nicholsoni*. The chief differences are in the respiratory



Text-fig. 12.—From left to right: antenna, submentum, lateral and dorsal views of tip of abdomen of larvae of *Simulium* spp.

apparatus (Text-fig. 10). Stem very short, 0.07 mm. (0.35 in *nicholsoni*), dark and spiny (paler and with smaller, paler spines in *nicholsoni*). The stem divides into four branches (immediately into six in *nicholsoni*), the medial and lateral of which again divide into two. The six filaments diverge more than in *S. nicholsoni*, but continue forward, and the tips curve inward towards each other. The filaments are about 2 mm. long, but their distal portions are delicate and readily broken off, perfect specimens being difficult to find.

In southern specimens the tubercles on the head and thorax are sparse and sometimes restricted to a narrow row on each side of the mid line. The gill filaments also tend to be shorter. In pupae from Tin Can Bay they are about 1.5 mm. long, and in those from Fraser Island they are remarkably short (about 1 mm.), and usually more robust, or at any rate the tips are usually intact. This is reflected also in the gill spot of the larva, the filaments being only long enough to complete one circle and the tips sometimes projecting out from the top of the spot.

*Larva.*

*S. faheyi* can be distinguished immediately from *S. nicholsoni* by its possessing compound rectal gills, each main digitation usually having three accessory lobes, though sometimes fewer. Other differences are minor. The head pattern of *nicholsoni* is negative, the median longitudinal stripe and two oval areas at the base on each side being pale; in *faheyi* the pattern (Text-fig. 11) is of similar form but indeterminate type, the median stripe often being pigmented, but the oval areas at base usually pale. The antennae are longer (about 0.35 mm.) in *nicholsoni* than *faheyi* (0.30 mm.). The ventral incisure extends about half-way to the base of the submentum and is rather square ended in *nicholsoni*; it is deeper and usually U- or V-shaped in *faheyi* (Text-fig. 2). In the gill-spit, the long, pale stem shows conspicuously on the anterior edge in *nicholsoni*, whereas in *faheyi* this edge is also pale, but the dividing filaments can be made out (Text-fig. 14). The ventral papillae are more conspicuous in *faheyi* than in *nicholsoni*.

*Distribution.*—Queensland: Innisfail district, Berner Creek (type locality), September, numerous larvae, pupae and bred adults; Babinda district: Lennon's Creek, small creeks on Babinda-Boulders Rd., jungle creek near Bramston's Beach, Russell River, Fishery Creek, all September. Southern Queensland: Figtree Creek, Fraser Island, April; creek near Tin Can Bay, April; Kin Kin Creek, near Lake Cootharabah, April; Six-Mile Creek, Cooroy, May—last three in company with *S. nicholsoni*; Blunder Creek, Oxley, April, May. The Lawn Hill specimen previously recorded appears to be correctly placed, but more material is needed to check the record from the Northern Territory.

*Biology.*

*S. faheyi* seems to be as abundant and widespread in the north as *S. nicholsoni* is in the south, and the early stages were found in broadly similar situations, having a preference for moderately fast, smoothly flowing, open streams, and especially for attachment to reeds and grass beneath the water. It was found alone or in company with *S. clathrinum* (which was equally abundant) in the north, and in company with one or more of *S. ornatipes*, *S. nicholsoni*, *A. furiosum* and *A. bancrofti* in the various southern streams. A female was taken at Bramston Beach attempting to bite man; in view of the abundance of the early stages, this habit would appear to be as occasional as in *S. nicholsoni*.

## The Genus AUSTROSIMULIUM Tonn.

## AUSTROSIMULIUM MIRABILE M. &amp; M.

*New distribution.*—Queensland: Babinda district, Smoko Creek, small jungle creek near Bramston's Beach, and small creek on Babinda-Boulders Road, all September. Springbrook area: unnamed creek at 1,300 ft., in company with *S. inornatum*, November; Purling Brook (2,000 ft.), December. (Previously only known from the type locality at Dawson's Creek on the slopes of Mt. Glorious, S.Q.)

## AUSTROSIMULIUM FULVICORNE n. sp.

*Types:* Holotype ♂, mounted on a slide, morphotype pupal skin and larva, in spirit, from Yanky Jack Creek, Fraser Island, February, D. Mackerras, in the Division of Entomology, C.S.I.R.O., Canberra, A.C.T.

*Distinctive features.*

Belongs to the *mirabile* group and most nearly related to that species, but so well differentiated that we feel justified in describing it on less material than we would ordinarily require. The male is distinguished from *A. cornutum* by the shape of the antennae and entirely yellow segments 4 to 10, and from *A. mirabile* by antennal coloration and absence of dark spots on the wing; the pupa from *A. mirabile* by the rounded, club-shaped end of the spiny respiratory horn; and the larva from *A. mirabile* by the longer, darkened basal segment of the antenna and by the head pattern.

*Male* (in spirit).

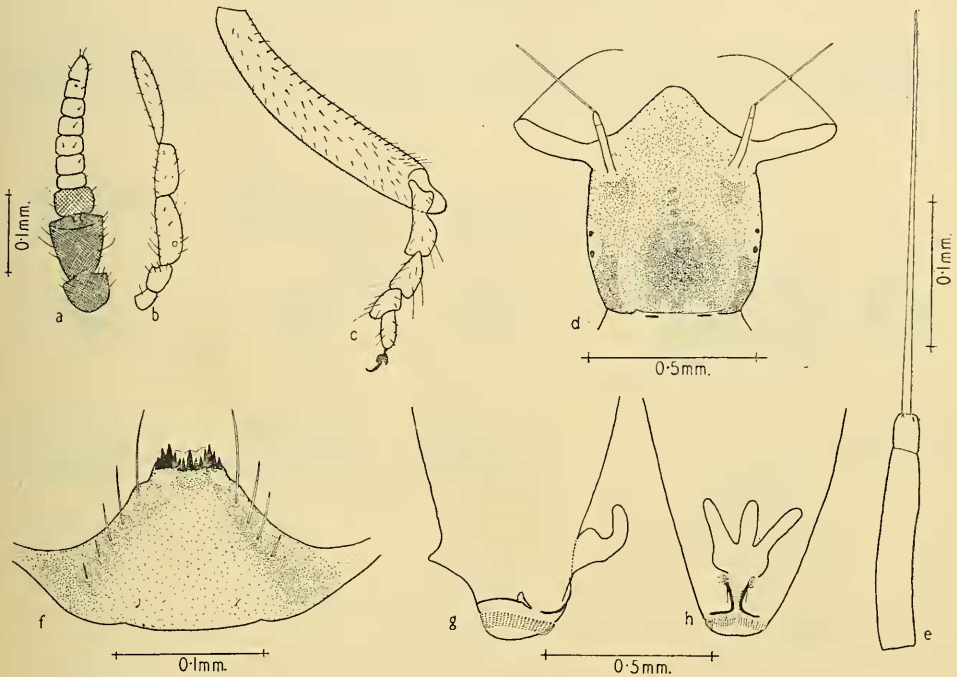
Length: Body (abdomen over-extended) 4 mm.; wing 1.8 mm. (the true size is about the same as *A. mirabile*).

*Head.*—Wider than thorax; upper facets of eyes moderately enlarged, in 15–16 rows. Antennae (Text-fig. 13) distinctly shorter than in *A. mirabile* but of same general form,

with second segment much longer than others; the ninth and tenth are incompletely separated (cf. *A. bancrofti*); first and second segments dark brown, third a brighter brown, fourth to tenth yellow. Face dark brown, with silvery hairs; mouth parts and palpi brown. There appear to be some golden hairs around the occiput.

*Thorax*.—Scutum dark brown, and appears to be covered with silvery scales. Pleurae brown.

*Legs*.—Not so uniformly dark brown as in a spirit specimen of *A. mirabile*. The fore and mid femora and tibiae are pale brown, almost yellowish, and the hind femur and tibia are also pale, but margined with dark pigmentation, especially on the tibia. All knees are yellowish. All tarsi (including hind metatarsus) are dark brown. Calcipala and pedisulcus as in Text-fig. 13. The claws are of normal male form.



Text-fig. 13.—*A. fulvicorne*. ♂: a, antenna; b, palp; c, hind tarsus. Larva: d, head pattern; e, antenna; f, submentum; g and h, lateral and dorsal views of tip of abdomen.

*Wings*.—Veins dark, and hairs on veins strong, with a few outstanding black hairs on basal section of R as in *A. mirabile*; but without the dark pigmented spots, except a trace at the fork of R, and completely without the groups of long dark bristles which are associated with these spots in *A. mirabile*. Halteres with stem brownish and knob creamy.

*Abdomen*.—Chitinous parts of tergites dark brown, membrane pale; hairs appear to be black. No trace could be seen of the silvery, tomentose patches, which are characteristic of *A. mirabile* and clearly visible on a spirit specimen as well as on pinned material. The hypopygium resembles that of *A. mirabile*, and has a similar acute setulose ventral swelling on the anterior part of the phallosome. The style, however, has only two spines, as in *A. cornutum* and *A. crassipes*. The spines are variable in *A. mirabile*; one specimen now before us has three on each side, and another four on one side and two and a small one on the other.

*Note*.—The colour description is to be taken as general rather than precise, and may require amendment when fresh material is available. The comparison with the male of *A. mirabile* was, however, made entirely on spirit specimens.

*Cocoon.*

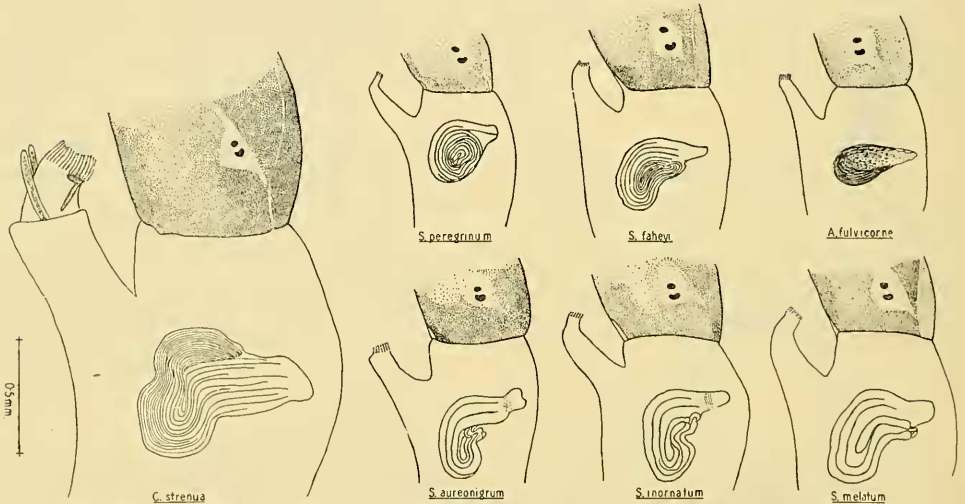
Length: 1.8 mm. Simple, finely woven wall-pocket type, with central dorsal projection, like that of *A. mirabile*.

*Pupa.*

Thoracic integument with exceedingly minute, irregularly distributed tubercles, and a large, stout, curved pair of posterior thoracic hairs as in *A. mirabile*. The abdominal chaetotaxy is apparently normal, but the specimen is somewhat damaged. The respiratory horn (Text-fig. 10) is flattened, blade-like, with rounded end, and covered with numerous strong, sharp, black spines. The filaments are not very numerous, arise mainly from the sides and internal surface and but few from the lateral surface, are rather longer than the horn, and of the usual beaded appearance.

*Larva.*

Length: 5 mm. Creamy white, with greyish brown mottling. Head with broad, dark pattern (Text-fig. 13), which is distinctly wider than in *A. mirabile*. Antennae similar to *A. cornutum*, with brownish basal segment, shorter than the paler, slender



Text-fig. 14.—Lateral view of full-grown larvae, showing gill-spots; note size of *C. strenua*. (This figure is intended for use in conjunction with our earlier figure—1949, Text-fig. 19, p. 403.)

distal segment (Text-fig. 13). Ventral incisure shallow, wider than deep (Text-fig. 2). Submentum as in Text-fig. 13, with five strong hairs on each side.

Gill-spot (Text-fig. 14) pear-shaped, dark, with the spiny horn distinctly visible.

Rectal gills simple. Large ventral papillae present. Anal sclerite with the usual backwardly directed struts and the incomplete ventral chitinous ring characteristic of the group, the upper end being swollen as in *A. mirabile* (Text-fig. 13). Circlet similar to other species.

*Distribution.*—Queensland: Only known from the type series from Fraser Island, comprising about 20 larvae and one adult male with its pupal shell and cocoon.

*Biology.*

The larvae and pupa were on grass in fairly swift, evenly flowing clear water in a small creek, deeply cut in the sand and shaded by vegetation growing over from the banks.

## AUSTROSIMULIUM CRASSIPES (Tonn.).

*New distribution.*—Queensland: Small tributary of Cave Creek (upper Numinbah Valley), March. (Previously known only from Victoria and the Blue Mountains, N.S.W.)

## AUSTROSIMULIUM BANCROFTI (Tayl.).

*New distribution.*—Queensland: Coastal creeks between Nambour and Gympie, February, April.

## AUSTROSIMULIUM PESTILENS, M. &amp; M.

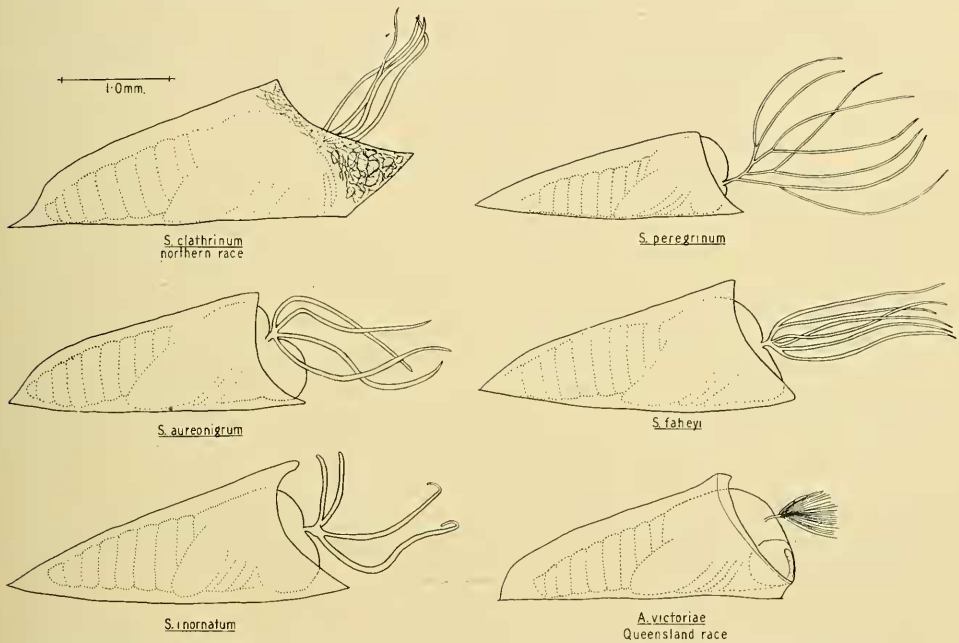
*New distribution.*—New South Wales: Nyngan, March, August, J. Armstrong. Not previously recorded outside Queensland; specimens kindly submitted by Mr. D. J. Lee, School of Public Health and Tropical Medicine, Sydney.

## AUSTROSIMULIUM FURIOSUM (Sk.).

*New distribution.*—Queensland: Fig-tree Creek, Fraser Island, April; several small coastal streams between Nambour and Gympie, April, May; Purling Brook, Springbrook area (2,000 ft.), December.

## AUSTROSIMULIUM VICTORIAE (Tonn.).

Queensland specimens differ from southern ones in that the long dorsal projections on the cocoon are completely missing (Text-fig. 15). Adults, pupae and larvae are, however, not to be separated from Canberra specimens, and we hesitate at present to use



Text-fig. 15.—Cocoons and pupae (for use in conjunction with our earlier figure—1949, Text-fig. 20, p. 404, but it is to be noted that the respiratory organ of one side only is shown here).

the cocoons alone to differentiate species or subspecies. Nevertheless, differences in the shape of the cocoon in different parts of the geographical range have been observed in other species also (*S. ornatipes*, *S. clathrinum*), and may indicate that genetic differences are developing. Much more material would be needed to attack this problem.

*New distribution.*—Queensland: Little Nerang Creek (300 ft.), September; Purling Brook and a small creek in the rain forest, Springbrook area (2,000 ft.), December. (Not recorded previously north of Wentworth Falls, N.S.W.)

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